

AMENDMENTS TO THE SPECIFICATION

Amend the specification by inserting before the first line the sentence:

This is a divisional of Application No. 09/708,653 filed November 9, 2000; the disclosure of which is incorporated herein by reference.

Amend the paragraph bridging pages 1 and 2 as follows:

However, in the above-mentioned conventional ultrasonic cleaning method, due to the ~~characteristic~~ characteristics of ultrasonic ~~waves~~ wave, ~~the~~ ultrasonic ~~wave is~~ waves are not able to effect the interior ~~part~~ parts of the bearing to be cleaned, which ~~result~~ results in insufficient cleaning ~~effect~~. Especially, since the bearing to be cleaned is simply immersed in the cleaning liquid, it is difficult to completely remove dirt particles existing between the rolling bodies and retainer of the bearing to be cleaned.

On page 2, amend the 1st full paragraph as follows:

Also, in the latter ultrasonic cleaning method, although the area of the bearing where the jetted cleaning liquid is applied can be cleaned, the cleaning liquid is splashed back from the ~~cleaning liquid applied~~ portions of the bearing where it is applied ~~portions~~, so that the portions of the bearing, where the jetted cleaning liquid cannot be applied directly, cannot be cleaned to a satisfactory degree. Therefore, it is difficult to completely remove dirt particles between the parts of the bearing to be cleaned, for example, between the rolling bodies and retainer of the bearing to be cleaned. Also, referring to an ultrasonic cleaning apparatus employed in enforcing the ultrasonic cleaning method, the structure thereof is complicated: that is, the ultrasonic cleaning apparatus is capable of cleaning a ball/roller bearing of a relatively large size but is not suitable to clean a ball/roller bearing of a small size.

Amend the paragraph bridging pages 2 and 3 as follows:

The present invention aims at solving the drawbacks found in the above-mentioned conventional ball/roller bearing cleaning methods. Accordingly, an object of the invention is to provide a ball/roller bearing cleaning method and apparatus which enables ~~to clean~~ highly ~~effectively~~ effective cleaning even the ~~shade providing~~ portions of the bearing ~~to be~~ that are shaded from being cleaned with respect to the cleaning liquid, as well as cleaning the dirt

particles caught between the parts of the bearing to be cleaned, that have been difficult to clean in the conventional ball/roller bearing cleaning methods.

On page 3, amend the 1st full paragraph as follows:

In attaining the above object, according to a first aspect of the invention, a cleaning method is provided—for a bearing composed of an inner ring, an outer ring, rolling bodies and a retainer—using cleaning liquid, wherein the cleaning liquid is made to flow through the bearing to be cleaned from the axial direction of the ~~present~~ bearing into spaces existing between the raceway surface of the inner ring and the raceway surface of the outer ring of the bearing to be cleaned and surrounding the rolling bodies and retainer.

Amend the paragraph bridging pages 3 and 4 as follows:

According to the present ball/roller bearing cleaning method, the cleaning liquid is supplied from the axial direction of the bearing to be cleaned and into spaces which exist between the raceway surface of the inner ring and the raceway surface of the outer ring of the bearing to be cleaned and also surround the rolling bodies and retainer, ~~the cleaning liquid is supplied from the axial direction of the bearing to be cleaned~~, whereby dirt particles caught in the part where the cleaning liquid cannot be applied directly, that is, dirt particles existing between the surfaces of the rolling bodies and retainer can be removed positively.

On page 4, amend the 1st full paragraph as follows:

Also, according to a second aspect of the invention, in the ball/roller bearing cleaning method according to the first aspect of the invention, the cleaning liquid is supplied in a state where the inner or outer ~~rings~~ ring of the bearing to be cleaned is fixed and the other is rotatable, whereby, while driving or rotating the rotatable ring of the bearing to be cleaned, the cleaning liquid can be flowed through the bearing to be cleaned.

On page 4, amend the 2nd full paragraph as follows:

In this method, while the inner or outer ~~rings~~ ring of the bearing to be cleaned is fixed, the other ring is rotated, so that the rolling bodies and retainer are rotated. Especially, since the rolling bodies are capable of rotating about their own axes as well as around the axis of the bearing, dirt particles existing between the rolling bodies and retainer can be scraped out efficiently and, by supplying the cleaning liquid forcibly into between the inner ring raceway

surface and outer ring raceway surface of the bearing to be cleaned, the thus scraped dirt particles can be discharged out of the bearing to be cleaned.

Amend the paragraph bridging pages 6 and 7 as follows:

This two-stage cleaning method is effective in the following case: that is, a large number of hard foreign substances are present in the interior portion of the bearing to be cleaned and thus, in case where the bearing to be cleaned is rotated in this state, there is a fear that the raceway surfaces of the inner ring and outer ring as well as the surfaces of the rolling bodies of the bearing to be cleaned can be damaged. Specifically, in the non-rotation cleaning step, the cleaning liquid is flowed through the bearing to be cleaned without rotating the same and, by radiating the ultrasonic waves onto the bearing to be cleaned from below, hard dirt particles existing in the interior portion of the bearing to be cleaned can be removed; and, after that ~~then~~, while rotating the bearing to be cleaned, it is cleaned. This can prevent the surfaces of the rolling bodies as well as the raceway surfaces of the inner ring and outer ring of the bearing to be cleaned from being damaged by the hard dirt particles.

Amend the paragraph bridging pages 7 and 8 as follows:

According to this ball/roller bearing cleaning apparatus, ~~in case where~~ when the cleaning liquid is supplied toward one surface of the bearing to be cleaned, the cleaning liquid is allowed to flow along the spiral grooves of the cylindrical-shaped rotary die to thereby rotate the cylindrical-shaped rotary die within the cleaning liquid supply passage and, due to a pumping action produced at ~~the then~~ that time by the spiral grooves, the pressure of the cleaning liquid is increased; and thus, the cleaning liquid having higher pressure than its initial pressure when it is supplied is jetted onto one surface of the bearing to be cleaned from the cylindrical-shaped rotary die. as a result of this, the cleaning liquid is forcibly made to flow from the axial direction of the bearing to be cleaned into spaces which are present between the inner ring raceway surface and outer ring raceway surface of the bearing to be cleaned and surround the rolling bodies and retainer, so that dirt particles existing between the rolling bodies and retainer can be scraped out therefrom and also can be then discharged out of the bearing to be cleaned.

On page 9, amend the 1st full paragraph as follows:

And, according to a ninth aspect of the invention, the ball/roller bearing cleaning apparatus according to the seventh aspect of the invention, preferably, may comprise a cleaning vessel filled with the cleaning liquid and an ultrasonically vibrating unit for applying ultrasonic vibrations to the cleaning liquid within the cleaning vessel.

On page 9, amend the 2nd full paragraph as follows:

According to this structure, since the ultrasonic waves can be radiated onto the inner ring, rolling bodies and retainer of the bearing to be cleaned, the whole interior portion of the bearing to be cleaned can be cleaned, thereby ~~being able to enhance~~ enhancing the cleaning effect.

On page 9, amend the 3rd full paragraph as follows:

Also, according to a tenth aspect of the invention, the ball/roller bearing cleaning apparatus according to the seventh aspect of the invention may also comprise a cleaning liquid jetting unit for jetting the cleaning liquid from obliquely above the bearing to be cleaned in the circumferential direction toward one side surface of the bearing to be cleaned, while the inner ring or outer ring of the bearing to be cleaned is rotatably supported on the surface layer portion of the cleaning vessel.

Amend the paragraph bridging pages 13 and 14 as follows:

The largest cylindrical groove 3b is fitted ~~into~~ between the bearing to be cleaned 1 and cylindrical-shaped rotary die 2 with a minimum clearance to thereby bring the bearing to be cleaned 1 on-center. The ~~second-state~~ second-stage cylindrical groove 3c forms a void below a location between the outer ring 1a and inner ring 1b of the bearing to be cleaned 1. And, the cylindrical-shaped rotary die 2 is inserted into the third-stage cylindrical groove 3d and is then secured to the fourth-stage smallest cylindrical groove 3e, whereby the cylindrical-shaped rotary die 2 is supported in such a manner that it can be rotated within the third-stage cylindrical groove 3d.

On page 17, amend the 2nd full paragraph as follows:

On the other hand, ~~in case~~ where there are clearances among the outer ring 1a, inner ring 1b and rolling bodies 1c, the outer ring 1a and inner ring 1b are allowed to rotate with respect to each other but there is a possibility that the rolling bodies 1c and retainer are disabled from

rotating with respect to one of the outer and inner rings 1a and 1b. That is, in such state, ~~in case~~ ~~where~~ when the inner ring rotates, only the inner ring 1b is allowed to rotate.

Amend the paragraph bridging pages 17 and 18 as follows:

In the ball/roller bearing cleaning apparatus 100 according to the present embodiment, while the inner ring 1b, rolling bodies 1c and retainer of the bearing to be cleaned 1 are respectively rotating, the cleaning liquid flows through several ~~paths~~ paths, which are respectively defined by and between the raceway surface of the outer ring 1a and the raceway surface of the inner ring 1b and surround the rolling bodies and retainer, from the axial direction of the bearing to be cleaned 1. Thanks to this, the cleaning liquid is able to clean well dirt particles (such as, the residuals of ground particles, dust produced by ~~grounding~~ grinding and cutting, and grinding liquid and the dirt particles of the grinding liquid) from the rolling bodies and retainer that are respectively disposed in the interior portion of the bearing to be cleaned.

On page 22, amend the 2nd full paragraph as follows:

According to the present structure, by supplying the cleaning liquid, the inner ring 1b, rolling bodies 1c and retainer (not shown) of the bearing to be cleaned 1 are rotated and, in addition, ultrasonic waves are radiated from the bottom portion of the cleaning vessel 22, so that the surface of each rolling body 1c rotating about its own axis can be ultrasonically cleaned, which can further enhance the cleaning effect of the rolling body 1c. Also, similarly to the ball/roller bearing cleaning apparatus according to the first and second embodiments, since the cleaning liquid flows through between the outer ring 1a and inner ring 1b, the present ball/roller bearing cleaning apparatus 400 is also excellent in removing the dirt particles ~~removing effect~~ and, especially, the rolling bodies 1c and retainer of the bearing to be cleaned 1 can be cleaned well.

Amend the paragraph bridging pages 22 and 23 as follows:

And, in the ball/roller bearing cleaning apparatus 400 according to the present embodiment, since the bearing to be cleaned 1 that has been cleaned once is turned upside-down and it is then cleaned again, the cleaning effect by the ultrasonic waves can be given to the rolling bodies 1c and retainer evenly, thereby being able to enhance the cleaning effect further.

Amend the paragraph bridging pages 26 and 27 as follows:

That is, as shown in Fig. 8, the present ball/roller bearing cleaning apparatus 700 is structured such that the ball/roller bearing cleaning apparatus 300 according to the third embodiment is stored within a cleaning vessel 22 and, in the bottom portion of the cleaning vessel 22, there is disposed an ultrasonic vibration plate 20. According to this structure, without rotating the bearing to be cleaned 1 by a conical-shaped die 15, the cleaning liquid of high pressure is forcibly made to flow through the bearing to be cleaned 1 and, in addition, ultrasonic waves are radiated from below the bearing to be cleaned 1, whereby the bearing to be cleaned 1 is kept from rotating while it is being cleaned. This makes it possible to prevent the bearing to be cleaned 1 from ~~damages~~ damage when hard dirt particles are present in the interior portion of the bearing to be cleaned 1, thereby ~~being able to clean~~ properly cleaning the bearing to be cleaned 1 ~~properly~~.